

Sheet (4)
Frequency Modulation

1) Calculate the FM signal bandwidth where the frequency deviation is 8 kHz and $f_m=4$ kHz. Write the FM equation if $A_c=18$ V, $f_c=3$ MHz.

2) An audio signal with amplitude $A_m=4$ V and frequency $f_m=1200$ Hz is used to modulate the frequency of a carrier signal with amplitude $A_c=8$ V and frequency $f_c=4$ MHz. With the modulation sensitivity $K_f=5652$ rad/sec/volt.

- a) Write the equation of the modulated signal.
- b) Calculate the Maximum frequency deviation.
- c) Calculate the modulated signal bandwidth.

3) A receiver picked up the signal

$$s(t) = 10\cos(2\pi(4 * 10^6)t + 0.8\sin(2\pi(600)t)$$

The modulating signal amplitude is 4 V

- a) Define the modulation type, calculate the bandwidth of the modulated signal and the carrier power.
- b) Draw the frequency spectrum of the modulated signal and calculate the frequency deviation.
- c) Show the effect of changing the modulating signal amplitude to 7V and changing the modulating signal frequency to 350 Hz.

4) For an FM modulator with a peak frequency deviation $\Delta f=10$ kHz, a modulating signal frequency $f_m=5$ kHz, $A_c=10$ V and a 500 kHz carrier. Determine:

- a) Number of sets of significant side frequencies, their amplitude and the bandwidth (using Bessel table).
- b) Draw the spectrum.
- c) Calculate the modulated signal power within the bandwidth.